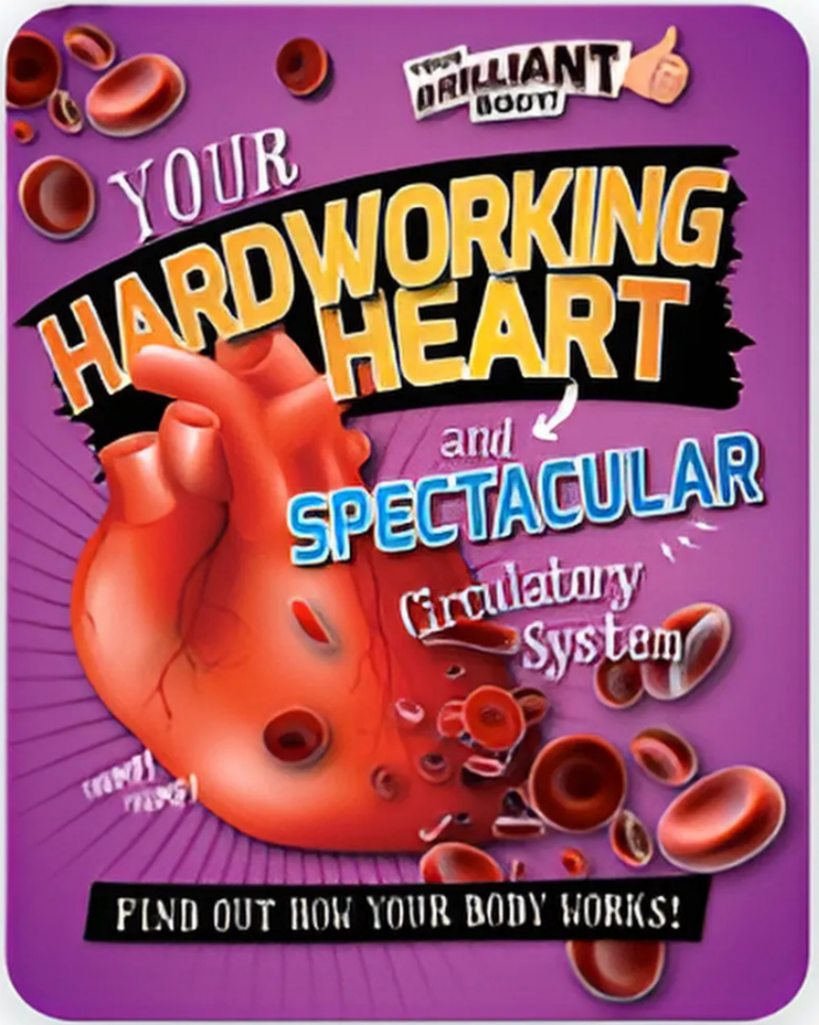

YOUR BRILLIANT BODY!

YOUR HARDWORKING HEART and SPECTACULAR Circulatory System

FIND OUT HOW YOUR BODY WORKS!

Paul Mason

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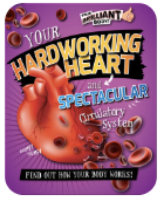

Your Hardworking Heart and Spectacular Circulatory System

Your Hardworking Heart and Spectacular Circulatory System takes readers on an entertaining tour of the body's heart and circulatory system.

BIOLOGY | THE WATER CYCLE | THE HUMAN BODY

Favorite

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About This Book

By: Paul Mason

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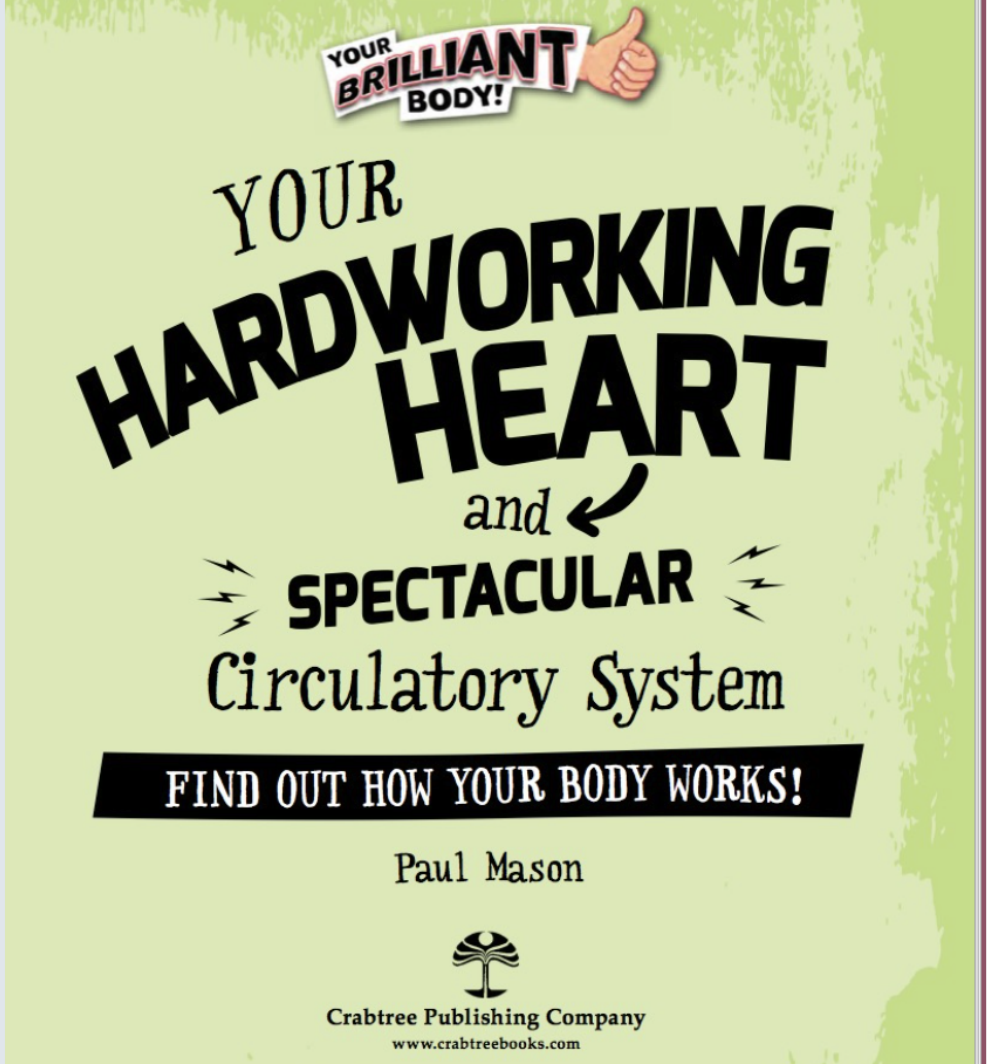

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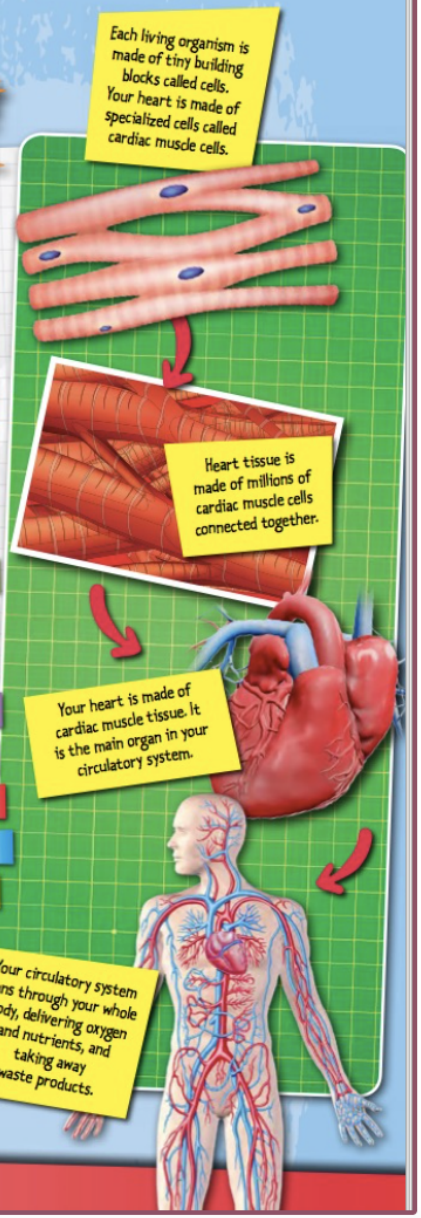


YOUR THUMPING HEART

Press two fingertips onto your inner wrist, beneath your thumb. Feel that pulse? It's caused by your heartbeat. Every pulse equals one beat. Your heart beats A LOT: almost 100,000 times a day, over 36 million times a year, and 2.5 BILLION times in a person's lifetime.

BRILLIANT BODY FACT

A human heart pumps roughly 1.5 million barrels of blood in its (and your) lifetime!

Pumping machine

Your heart's job is to pump blood around your body. The blood transports the **oxygen** and **nutrients** the body needs. The blood also carries away waste products. This is essential to keep you alive.

Luckily, your heart is REALLY good at pumping blood. An average adult's heart pumps over 1,981 gallons (7,500 L) of blood a day. It even generates its own electricity to keep itself going!

Boys vs. girls

Boys' hearts are usually bigger than girls' hearts by about 20% because their body size is generally bigger. Partly to make up for their smaller size, female hearts pump faster, at an average of roughly 78 beats per minute for adults, compared to an adult male's 70 beats. People who are physically fit have a slower heartbeat. Their hearts are stronger, so they can pump more blood with each beat. Some athletes have a heartbeat as low as 30 beats per minute, or even fewer.

DID YOU KNOW?

Hearts work without their owners.

Human hearts have their own electrical system, so they can carry on beating even when separated from the body! They just need a blood supply, plus the right conditions to keep their cells alive.

Laid end to end, your blood vessels would circle the world almost 2.5 times!

Blood and blood vessels

The blood pumped by the heart travels around the human body through a network of almost 62,000 miles (100,000 km) of **blood vessels**. Blood vessels are tubes that run throughout your body to carry blood to and from your heart.

DON'T TRY THIS AT HOME!

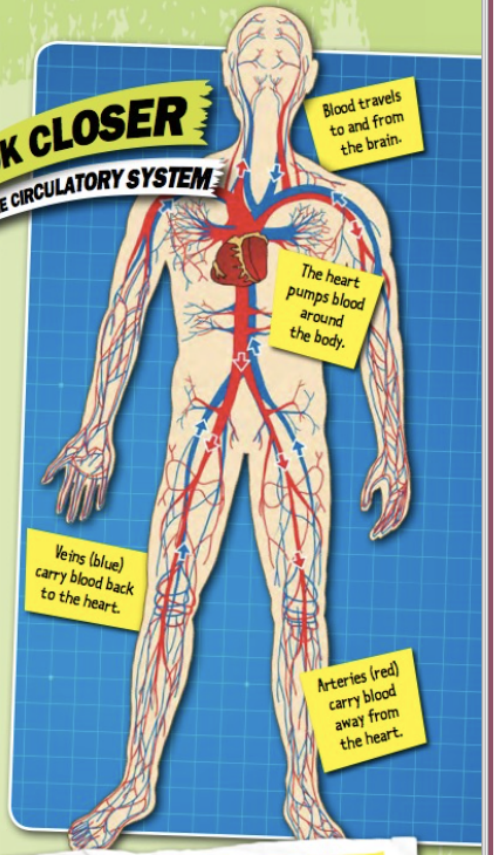
In 1929, a German surgeon called Werner Forssmann decided to do an experiment.

Forssmann pushed a flexible tube into one of the veins in his arm. After about 23.6 inches (60 cm) of tube had gone in, the end had reached Werner's heart. He had invented a new way of giving patients drugs. Werner was later awarded the Nobel Prize for Medicine. He lived a long life and died at the age of 74—of heart failure.

Werner Forssmann

LOOK CLOSER

THE CIRCULATORY SYSTEM



See for yourself

In normal use, a healthy heart NEVER gets tired–despite beating roughly once every second of your life. Try squeezing a tennis ball once a second for a minute or two and you will start to see how amazing this is!

HEART PARTS

Stick a finger in each of your ears, so that you completely block out sound. You should still be able to hear something: lub-dub; lub-dub; lub-dub. It's your heart pumping blood around your body.

BRILLIANT BODY FACT

Your heart is about the same size as your fist. (An adult's is bigger.)

Pumping blood

Your heart is a great big ball of muscle. It pumps blood by **contracting** and relaxing in a complicated sequence. The noise you can hear is blood moving between different parts of the heart as it works to **circulate** blood around your body.

Four parts to each heart

Your heart has two sides, left and right. Each side is a separate pump. Each pump has two chambers. The upper chambers are called **atriums** and the lower chambers are called **ventricles**. Strong **valves** separate the chambers; they open only to let blood flow from the upper chamber to the lower chamber.

Arteries and veins

Your heart is connected to the circulatory system by **arteries** and **veins**. Arteries take blood away from the heart. Veins bring it back. Arteries, veins, and smaller blood vessels are organized into two networks. One carries blood to and from your lungs. The other carries blood to and from the rest of your body.

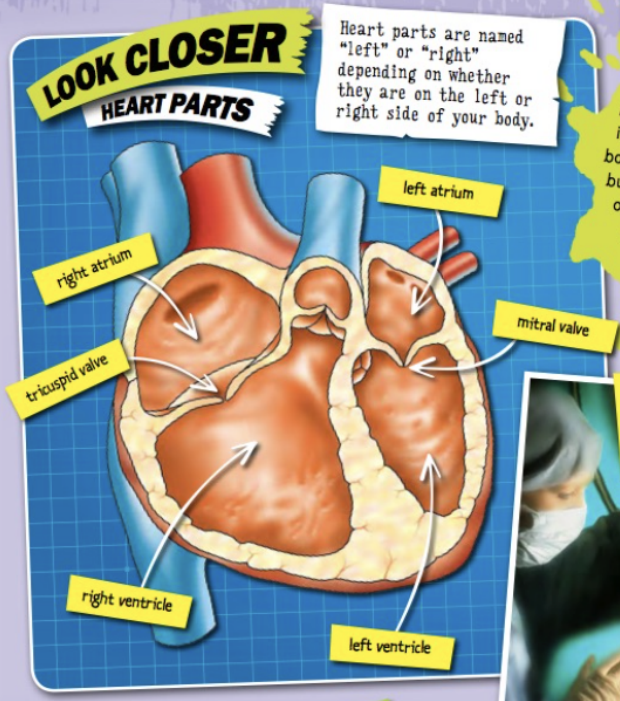
DON'T TRY THIS AT HOME!

Before 1925, if you had a problem with the valve between the upper and lower chambers of your heart, you usually died.

In Britain, Dr. Souttar thought he could solve this problem. He cut a hole in a patient's heart and stuck his finger inside to try and clear the valve. When Dr. Souttar's bosses heard about the operation, they told him it was too dangerous and he shouldn't do it again.

LOOK CLOSER

HEART PARTS

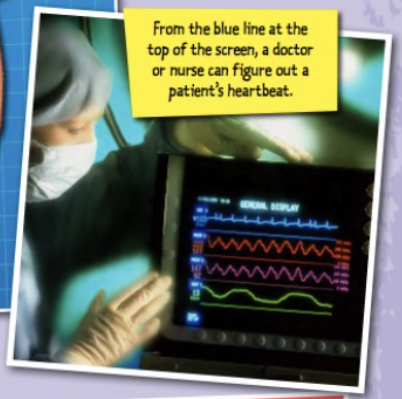


Heart parts are named "left" or "right" depending on whether they are on the left or right side of your body.

DID YOU KNOW?

Hearts are not on the left.

Many people think your heart is only on the left side of your body. It's actually in the middle, but tilted slightly left. Because of this, your left lung has to be slightly smaller than your right lung.



From the blue line at the top of the screen, a doctor or nurse can figure out a patient's heartbeat.

STRANGE BUT TRUE!

The blue whale has the largest heart of any animal. Each minute, it beats about five times (compared to an adult human's 70 times) and pumps about 1,849 gallons (7,000 L) of blood. Wow!

WHAT MAKES A HEART BEAT?

Have you heard the story of Frankenstein's monster—a creature stitched together from spare body parts, brought to life with a massive electric shock? It might surprise you to know that you have something in common with the monster. Without electricity, your heart (and therefore YOU) wouldn't be alive.

BRILLIANT BODY FACT

Your heart triggers each beat with a tiny electrical charge.

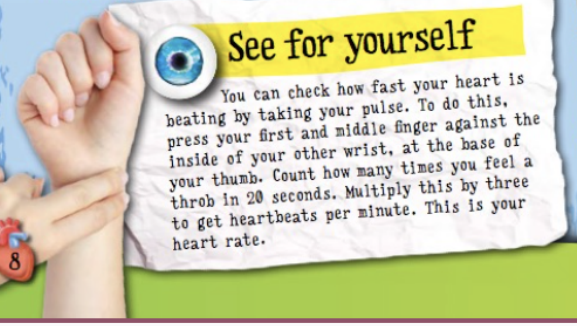
Shocking

Your heart is controlled by what is sometimes called "nature's **pacemaker**." Its proper name is the **sinoatrial node**—or SA node for short. The SA node is part of your heart's wall, and it sends an electric signal that triggers each heartbeat. The signal starts a complicated process of muscle contractions that control a one-way mechanism of valves opening and closing.

A one-way system

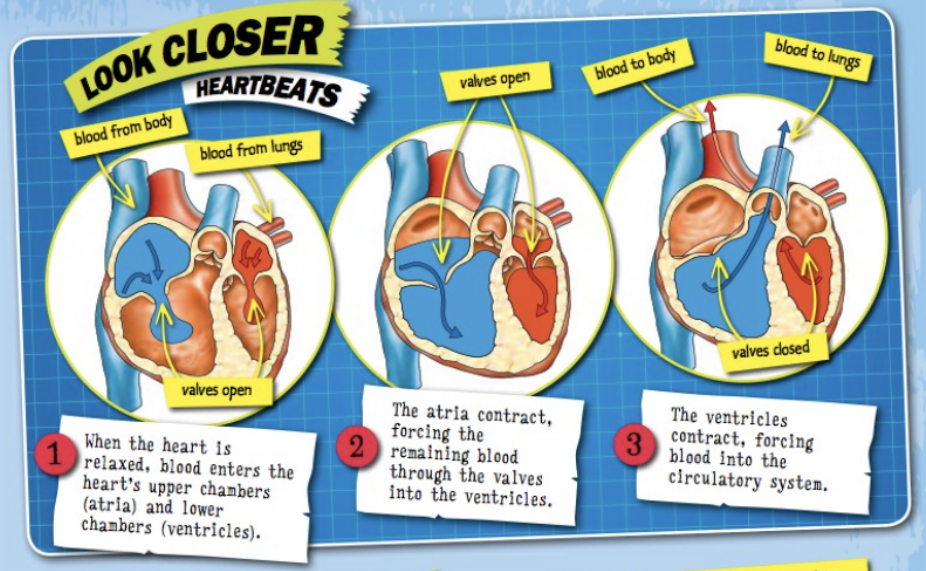
The valves between the upper and lower chambers of your heart work only one way. They open to allow blood to move down into the ventricles. Then the valves close, making it impossible for blood to flow back to where it came from.

As well as the valves within your heart, there are valves at the exits to the arteries that carry blood away. Together, these valves (and others like them in your blood vessels) make sure that your circulatory system is one-way only.



See for yourself

You can check how fast your heart is beating by taking your pulse. To do this, press your first and middle finger against the inside of your other wrist, at the base of your thumb. Count how many times you feel a throb in 20 seconds. Multiply this by three to get heartbeats per minute. This is your heart rate.



STRANGE BUT TRUE!

Your heart rate gets slower as you grow up.

During childhood you grow quickly. Your heart beats fast, circulating nutrients and oxygen. Once you are fully grown, it beats more slowly.

Typical pulse rates

Newborn:	130
1 year:	120
6 years:	100
12 years:	85
Adult:	60-75

A human heart is covered in a layer of fat, which makes it look yellow. Underneath the fat, hearts are a reddish-brown color.

BLOOD (AND IRON)

BRILLIANT BODY FACT
The blood in your body makes up about 7% of your total weight!

Your blood is powerful stuff (despite being mostly water). For a start, it has a distinct smell. A great white shark can detect a few drops in the sea from up to three miles (5 km) away. Up close, the smell of blood is strong enough for even humans to notice.

Red blood cells

The smell of blood is often described as metallic—which is no coincidence. The red cells in your blood are made mostly of a **protein** called **hemoglobin**, which contains iron. The iron helps your red blood cells transport oxygen around the body. This is an important job—without oxygen, your body quickly shuts down and dies.

You can guess how important red blood cells are by the number your body produces.

Every day, an adult produces about 200 BILLION (to be more exact, 207,360,000,000) new red blood cells.

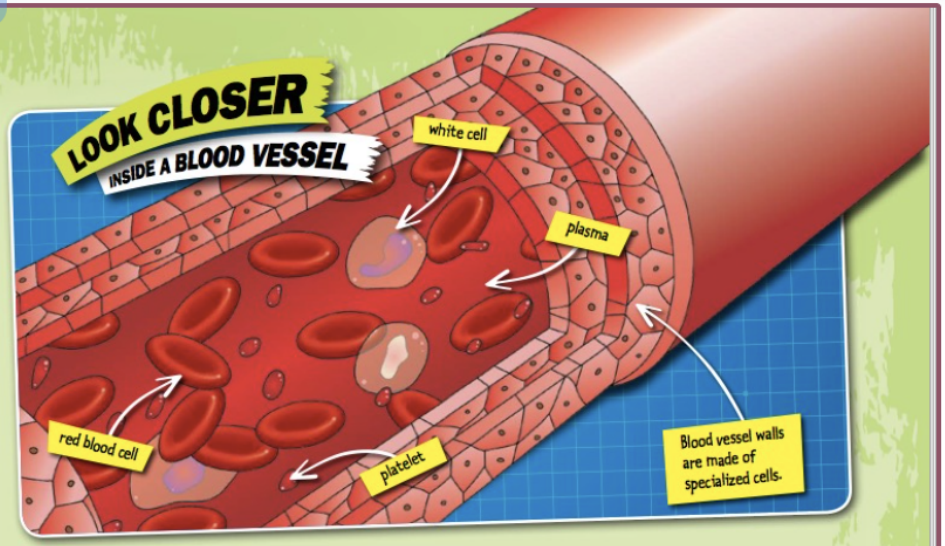
Other parts of your blood

Although it's red, your blood is not just made of red cells. It has three other important parts:

* **White cells** are your body's doctors. They fight infections and help keep your body safe from diseases and microscopic intruders. White cells are good, but they can be annoying—when you get a zit, it's because a bunch of white cells have got together to fight an infection in your skin!

STRANGE BUT TRUE!

Human blood is red because it contains iron. A horseshoe crab's blood contains copper instead—so horseshoe crabs have blue blood!



* **Platelets** are tiny cell fragments that gather around a cut to form a **clot** and stop any bleeding.

* **Plasma** makes up 55% of blood and is mostly water. It carries the platelets, red cells, and white cells (plus nutrients and other chemicals) around your body.

DON'T TRY THIS AT HOME!

In the 1660s, scientists experimented with taking the blood of one dog and putting it into another dog.

Few of the dogs survived. By 1818, Dr. James Blundell had started performing blood **transfusions** on humans. Few of his patients survived.

It would be the 1900s before people figured out why this was happening—find out more on page 15.

See for yourself

YOU CAN MAKE A BLOOD-LIKE MIXTURE TO HAVE A LOOK AT ALL THE DIFFERENT PARTS.

* Take a small, clear bowl and fill it halfway with a mixture of two-thirds corn syrup, one-third warm water, and a few drops of red food coloring.
* Then add a handful of red Skittles, a dinner mint, and a teaspoon of sprinkles.
* Stir the mixture until it turns red!

The corn syrup mixture is the plasma, the Skittles are red blood cells, the mint is a white blood cell, and the sprinkles are platelets!

(You can swap the ingredients for any you find that are a similar color and shape.)

WHAT COLOR IS YOUR BLOOD?

BRILLIANT BODY FACT

Just one drop of your blood contains five million red blood cells.

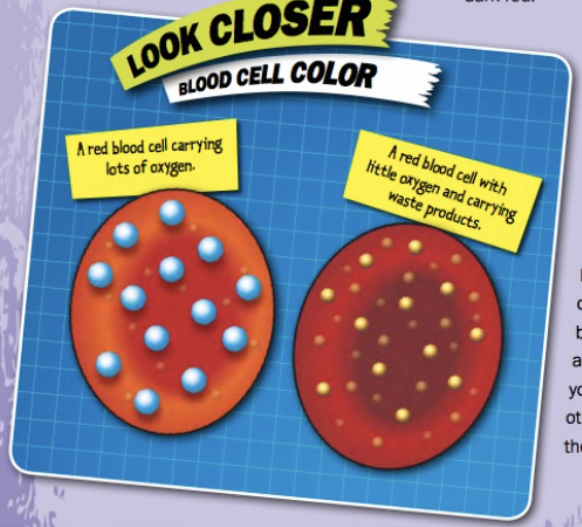
Human blood is red, obviously! But whether your blood is bright red or dark red depends on where it is in your body, and what it's been doing.

Fetching and carrying

Blood gets its color from a chemical reaction between the iron in your red blood cells and the oxygen they carry. Blood that is carrying more oxygen is brighter red. Blood that has gotten rid of most of its oxygen is a deep, dark red.

LOOK CLOSER

BLOOD CELL COLOR

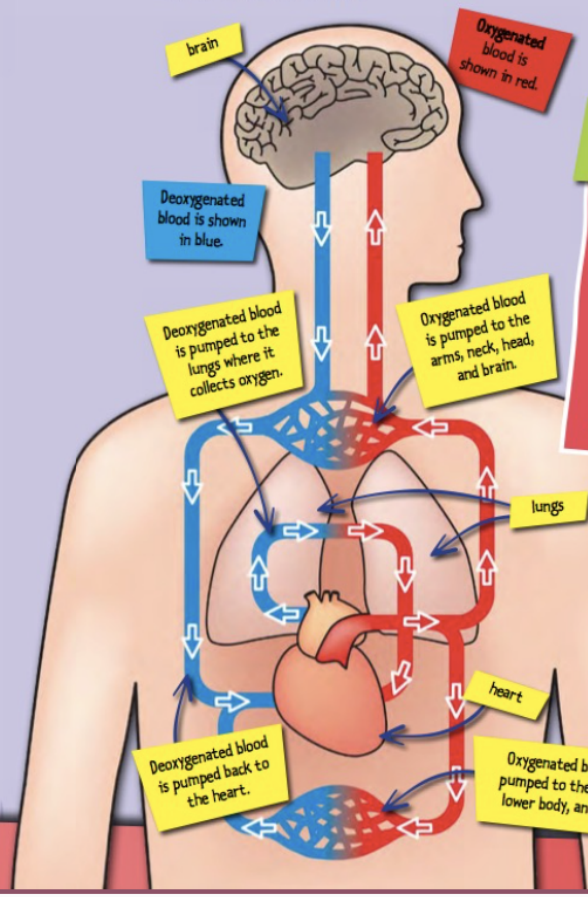


Where is blood brightest?

Your blood is brightest red when it has collected a fresh supply of oxygen from your lungs. It travels to the left side of the heart ready to be pumped to the rest of your body. The red blood cells deliver oxygen all over the body. The blood also collects and redistributes nutrients from your digestive system, and other chemicals wherever they are needed.

Where is blood darkest?

Blood is darkest on its journey from the right side of the heart to the lungs. This blood has little oxygen and is loaded down with waste products, particularly carbon dioxide (CO_2) gas. These are released at the lungs, where the red blood cells collect more oxygen and return to the left side of the heart.



DID YOU KNOW?

Your body contains enough iron to make a nail.

It would be a big nail, too: about 1.6 inches (4 cm) long. In an adult, the nail would be *twice* that size! Almost all the iron in your body is contained in hemoglobin. This is carried by red blood cells and does lots of important jobs.

STRANGE BUT TRUE!

Bruises form when your body gets bumped or banged and tiny blood vessels are crushed. They start leaking blood, which is why a bruise starts off as a reddish-brown color.

As the blood vessels are repaired, and the leaked blood is taken away, the bruise changes color—first to purple, then green or yellow, and finally light yellow or brown.

Ouch! You can see the damaged blood vessels in this bruise.

TYPES OF BLOOD

BRILLIANT BODY FACT

The rarest blood is AB negative—only one person in 100 has this type!

Not all blood is the same. For a start, some people have a protein called Rh in their blood. Rh is short for "rhesus." The protein gets its name from being first discovered in rhesus monkeys!

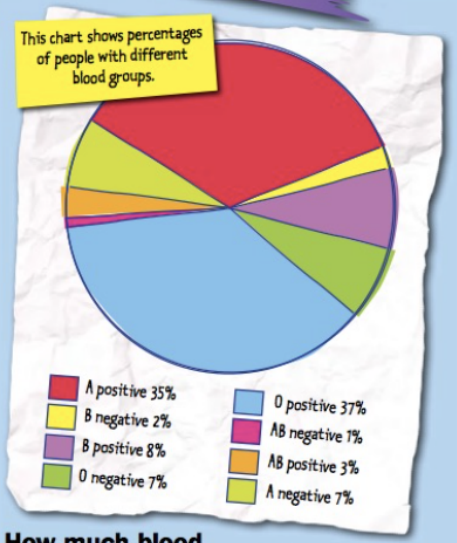
rhesus monkeys

Positive and negative

There's a good chance that the blood in your circulatory system has the Rh protein. Blood with the Rh protein is described as "positive." Roughly four in five people have positive blood. Blood without the Rh protein is called "negative."

Positive or negative is not the only difference between people's blood. Other proteins also decide whether your blood is in groups A, B, AB, or O. In total, there are eight different blood groups.

This chart shows percentages of people with different blood groups.



How much blood can a human lose?

Sometimes, an accident or illness causes people to lose blood. Most people could lose about 15% of their blood without any serious harm. Any more and the person would start to feel dizzy, cold, irritable, or all three.

Losing more than 30% of your blood makes it difficult for blood to get back to your heart, which can be **fatal**. Losing 50% or more will almost certainly cause death.

Matching blood types

For anyone who loses a lot of blood today, it is possible to transfer blood safely from one person to another. This is called a transfusion. The blood comes from volunteers, who have donated their blood so that it can be stored until it is needed. They are called **blood donors**.

Not everyone's blood can be given to everyone else. O-negative blood can be transfused to anyone, so people with this blood type are often called **universal donors**. But people from some blood groups need blood from exactly the same group.

Donated blood is stored and ready to be used.

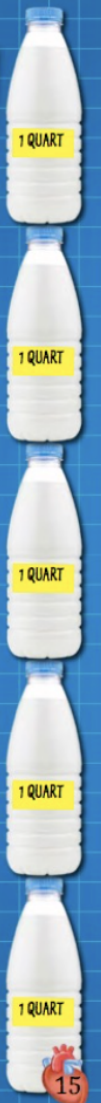
STRANGE BUT TRUE!

Humans have four basic blood types (A, B, AB, O), and so do dogs. Cats have 11 different blood types, which seems like a lot—until you realize that cows have 800!

DID YOU KNOW?

Your blood group DOESN'T determine your personality.

In Japan, many people think your blood type determines your personality. They ask "What's your blood type?" the same way other people ask, "What's your star sign?" There is no evidence that your blood group DOES actually influence your personality.



An average adult has around five quarts (5 L) of blood in their body. When you donate blood, your body makes more.

BLOOD VESSELS

BRILLIANT BODY FACT

The body's largest blood vessel—the **aorta**—is the same diameter as a garden hose.

Look at a nearby adult. Inside his or her body, there are a lot of blood vessels, carrying blood around. In fact, if you laid the blood vessels in a line, they would stretch a quarter of the distance to the Moon.

Blood vessels

Every time your heart beats, it pumps blood around this huge network of blood vessels. There are three basic types of blood vessel: arteries, veins, and capillaries.

✱ **Arteries** These take blood away from the heart. The blood inside an artery is under high **pressure**—so high, in fact, that if a tiny hole is made in an artery, the blood is said to squirt out up to 29.5 feet (9 m) with every heartbeat.

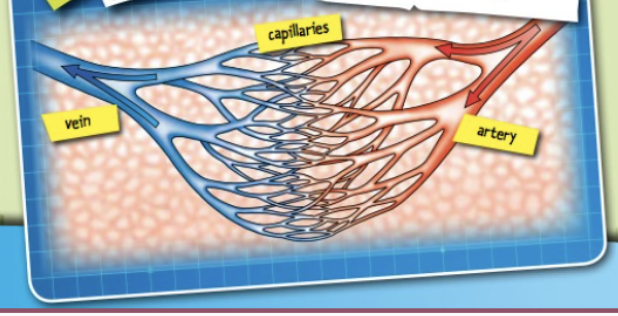
✱ **Veins** These bring blood back to the heart. The blood that is a long way from the heart is under less pressure. So veins often contain valves (like the ones in the heart, see page 8) to make sure the blood does not go backward.

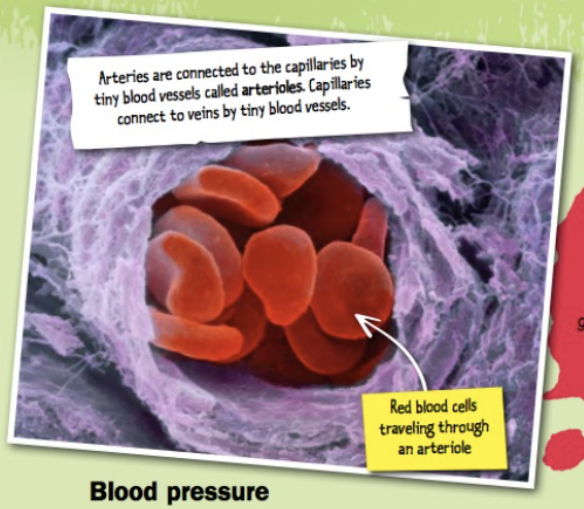
✱ **Capillaries** These tiny blood vessels connect the bigger blood vessels to the rest of the body. Their walls allow gases, liquids, and chemicals to pass through them, and into other parts of your body. As blood passes through the capillaries it delivers oxygen and collects waste.

LOOK CLOSER

BLOOD VESSELS

Blood leaves the heart in arteries. These divide into a network of tiny capillaries. These then link together to form veins, which carry deoxygenated blood back to the heart and lungs.





Blood pressure

When people on medical TV shows shout out phrases like "140 over 90," they are talking about the patient's **blood pressure**—how strongly his or her blood is passing through the circulatory system. If the blood is not circulating strongly enough, the body will slowly be starved of oxygen and nutrients, and overloaded with carbon dioxide.

The first number is maximum blood pressure, which is recorded when blood is pumped out of the heart. The second number is the patient's minimum blood pressure, recorded when the heart relaxes and fills with blood.

STRANGE BUT TRUE!

Drinking coffee or energy drinks containing caffeine raises your blood pressure. But, having a pet dog or cat has been shown to lower people's blood pressure!

DID YOU KNOW?

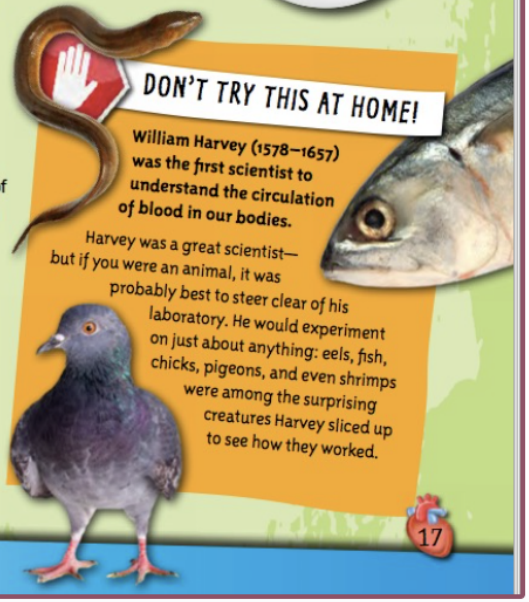
Your cornea has no blood vessels.

The **cornea** is a clear layer at the very front of your eye. Even tiny blood vessels inside it would get in the way of your vision, so the cornea has no blood supply of its own. Instead it gets oxygen directly from the air, and nutrients from tears and clear fluid.

DON'T TRY THIS AT HOME!

William Harvey (1578–1657) was the first scientist to understand the circulation of blood in our bodies.

Harvey was a great scientist—but if you were an animal, it was probably best to steer clear of his laboratory. He would experiment on just about anything: eels, fish, chicks, pigeons, and even shrimps were among the surprising creatures Harvey sliced up to see how they worked.



THE BODY'S DELIVERY SERVICE

Your blood system is like a nonstop delivery service for your body. Every second you're alive, your circulatory system collects and delivers food, oxygen, and other important items, such as hormones, wherever they are needed.

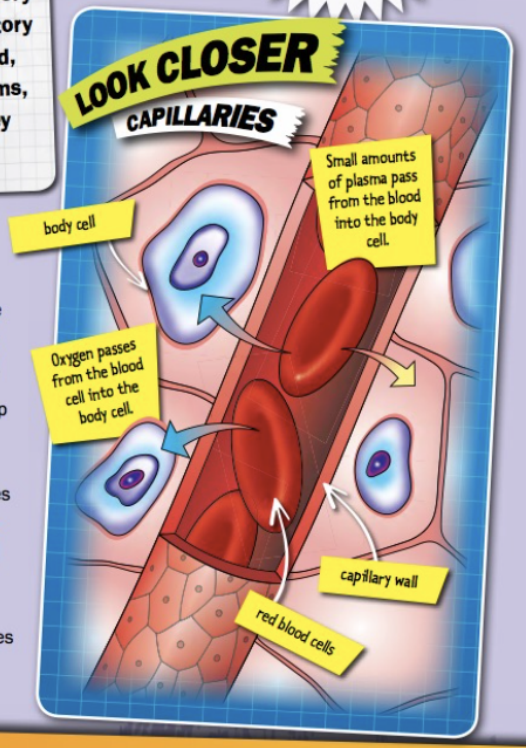
BRILLIANT BODY FACT

Your blood delivers supplies to about 37 trillion cells inside your body.

Crucial capillaries

Collection and delivery is done by your capillaries. These tiny blood vessels have small openings in their walls, which allow chemicals to pass to and from the blood.

For example, in the lungs, capillaries wrap themselves around tiny air sacs called **alveoli**. As the blood flows past, oxygen passes from the alveoli into the capillaries through the vessel wall. It then flows into larger blood vessels for transport around the body. When this blood reaches a muscle or another body part in need of oxygen, the oxygen is released and passes into the body cells.



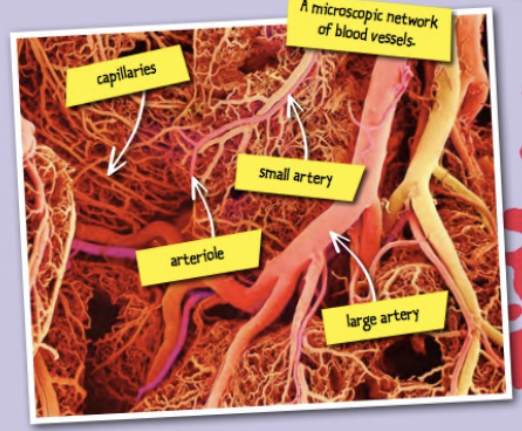
More energy needed

As well as oxygen, blood delivers nutrients around the body. For example, if you go running, your muscles use up their stored energy. They signal to your brain that more is needed. Your brain tells your lungs to breathe harder, and your heart to beat faster. Your blood picks up more nutrients from your digestive system and transports them to your muscles.

See for yourself

Just how small is a capillary? They range from about five to 10 micrometers wide (a micrometer is a thousandth of a millimeter).

To give you an idea of how small this is, compare an average human hair. That's about 100 micrometers thick: 10 times as wide as the biggest capillary!



DID YOU KNOW?

How hormones work

How do hormones in your blood deliver their message to the exact part of your body where they are needed? Hormones work by fitting themselves to a cell's **receptor**. Receptors come in lots of different shapes. Only a hormone with the exact-same shape on its outside will fit the receptor and deliver its message.

A side order of hormones

As well as oxygen and nutrients, your circulatory system delivers **hormones**. These are chemical messengers that tell different parts of your body how to behave. For example, hormones control when you go to sleep, grow, feel hungry—and even how fast your heart beats.

Hormones can affect your mood—making you happy, sad, angry, or annoyed.

THE BODY'S GARBAGE SERVICE

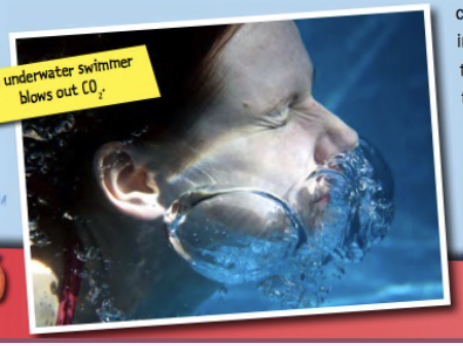
As well as being a delivery service, your circulatory system also does nonstop garbage collection. It takes away waste and by-products that the body no longer needs. Getting rid of these requires help from the lungs and two crucial little organs: the kidneys.

BRILLIANT BODY FACT

It takes only one hour for your kidneys to clean every drop of blood in your body.

Expelling poison gas

When your muscles burn energy, one of the by-products is a gas called carbon dioxide, or CO_2. Large amounts of this gas can be poisonous to humans, so your body needs to get rid of it quickly! Fortunately, blood that has delivered its oxygen to the muscles has space to take on waste products. The CO_2 is transported to the lungs for us to breathe out.

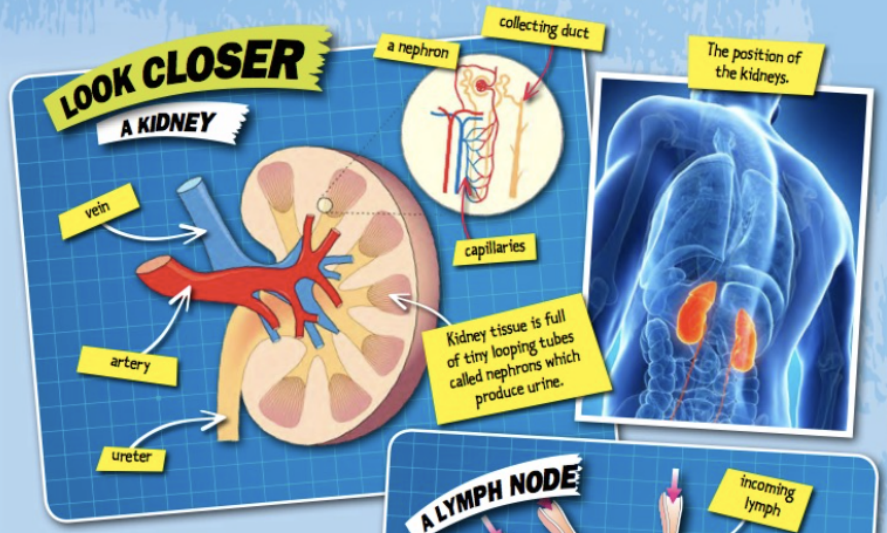


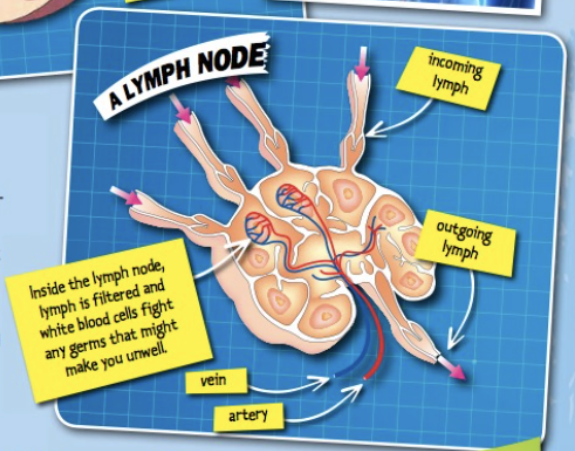
An underwater swimmer blows out CO_2.

Two million tiny blood filters

At any one moment, almost 25% of the blood leaving your heart is heading for your kidneys to be cleaned. When the blood arrives, it is fed into the **renal** pyramids. These are full of tiny, looping tubes called **nephrons**. Each nephron is a separate blood filter, and you have about one million nephrons per kidney.

All those nephrons are constantly cleaning your blood, putting the waste into urine. The urine moves down a tube called the ureter, from the kidney to your bladder. This is a sac with muscular walls, where urine is stored. Once your bladder is full, your brain sends a warning that it's time to use the restroom.





The lymphatic system

The kidneys aren't your only clean-up crew. Your body also comes equipped with a drainage network called the lymphatic system. This collects fluid, known as **lymph**, from all around the body. The fluid is forced through tiny structures called **lymph nodes**, which filter out impurities.

The lymph system also helps your body fight disease. The lymph nodes add disease-fighting white blood cells to the blood. They also contain **macrophages**—specialized blood cells that can destroy unwanted particles, such as germs.

STRANGE BUT TRUE!

When empty, an adult's bladder is about the size and shape of a pear. When full, it can hold around two cups (470 ml) of urine—that's about the same amount as a small water bottle.

DEFENSE AGAINST MICROBE ATTACKS

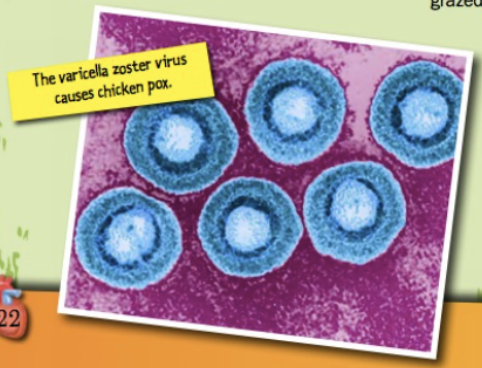
Your body is constantly under attack! Tiny organisms called microbes are always trying to get inside. There are A LOT of them, too—you probably have more microbes just on your hand than there are people on Earth.

BRILLIANT BODY FACT

Your disease-fighting white blood cells triple in number when you are sick.

Many microbes

Not all microbes are harmful. Microbes in your intestine can provide you with healthy vitamins. But some microbes are dangerous. If they manage to get inside you, they can make you sick. One example is a type of microbe called a **virus**. Viruses cause diseases ranging from ordinary colds or warts to measles and chicken pox.



The varicella zoster virus causes chicken pox.

Fortunately, your body has a good defense system against microbes—and your blood plays an important part.

Cuts and scabs

Your biggest defense against microbes is your skin, a barrier they cannot get through. Sometimes, though, your skin gets cut or grazed. Blood rushes to the spot. Platelets in the blood stick together like glue, forming a barrier. The barrier also contains other blood cells and thread-like material called **fibrin**. The fibrin helps to hold the barrier together as it forms into a scab. The scab forms a barrier while your skin and the tissue underneath heal.

White blood cells

If any microbes DO get into your body, white blood cells will attack them. They do this in two different ways:

- Some white cells surround and destroy things that shouldn't be in your body.
- Other white cells produce chemicals called **antibodies**, which fight microbe invaders—including viruses. Some are even able to remember particular types of virus. This helps them destroy the virus even faster the next time it appears.

White blood cells are larger than red ones.

See for yourself

Just how small are viruses? Really VERY small.

To get an idea of how tiny viruses are compared to your body's normal cells, imagine that a virus is the size of a baseball. In comparison, your body's normal cells would each be the same size as the whole baseball field!

DON'T TRY THIS AT HOME!

The existence of viruses was first proved in 1901, by a U.S. army team working in Cuba.

The theory was that yellow fever might be spread by something carried by mosquitoes. To establish whether this was true, volunteers allowed themselves to be bitten by mosquitoes. Many of the volunteers DID develop yellow fever. Some members of the research team even died of the disease.

YOUR CIRCULATION —OUT OF THIS WORLD

You might think that your circulatory system works pretty much the same way, wherever you are. You'd be wrong though—and to prove it, all you need to do is visit outer space. Just a few weeks aboard the International Space Station (ISS) should do it!

BRILLIANT BODY FACT

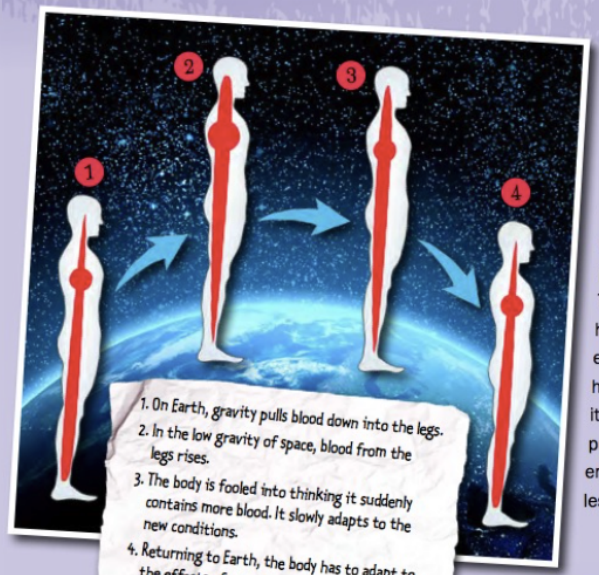
After just two days in space, your face puffs up (because of extra blood in your head)!

Designed for Earth

Your body is well designed for life on planet Earth. Leaving Earth has strange effects on the human body. One of the most important is that our bodies are tricked into producing less blood.

On Earth, **gravity** means that blood normally collects in your legs. This blood then has to fight gravity to get back up to your heart. In fact, it would have a hard time doing this without the valves in your leg veins, which act like a ladder for the blood moving up your legs.

An astronaut aboard the International Space Station



1. On Earth, gravity pulls blood down into the legs.
2. In the low gravity of space, blood from the legs rises.
3. The body is fooled into thinking it suddenly contains more blood. It slowly adapts to the new conditions.
4. Returning to Earth, the body has to adapt to the effects of gravity.

Zero gravity

In space, there's no gravity, so blood does not collect in your legs—it builds up in your chest and head instead. Your brain thinks your body contains too much blood overall. First, you get headaches and a puffy face. Then your heart gets bigger, to handle the extra blood flow it's expecting. At the same time, your heart becomes weaker because it does not have to fight gravity to pump blood up your body. In the end, your body starts to produce less blood.

YOU CAN'T TRY THIS AT HOME!

Astronauts sometimes faint, or experience "gray-out" during takeoff.

This happens because gravity has trapped too much blood in their legs, so not enough reaches their brain. Astronauts may also faint when they return to Earth. After a long space visit, their heart isn't used to fighting gravity and struggles to get enough blood to their brain.

STRANGE BUT TRUE!

During a long stay in space, astronauts can lose up to a quart (1 L) of fluid from EACH LEG. Without this fluid, your legs start to look thin and loose-skinned. This is sometimes called "chicken legs."

HELPING HEARTS

BRILLIANT BODY FACT

Most of the time, your heart only works at roughly half its maximum capacity.

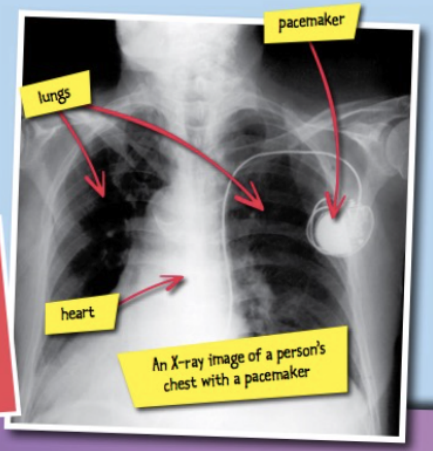
An adult's heart can beat almost 200 times a minute, such as when someone is exercising hard. Normally it only needs to beat about 70 times. So, even someone whose heart is not working properly can do simple tasks easily. However, sometimes people develop heart problems that need treatment.

Heart problems among children

Roughly one in 100 babies are born with some kind of heart problem. Signs of a heart problem include difficulty breathing, chest pains, and an irregular heartbeat. Drugs, surgery, or other medical treatment can often provide a cure. Most children with heart problems grow up to be healthy adults.

Improvements in treatment

Every year, new and better treatments are being developed for those with heart problems. For instance, someone with an irregular heartbeat might need a pacemaker—an electrical device that tells the heart when to beat. The first heart pacemakers were complicated devices that were painful for patients. Today, they are tiny battery-powered boxes that a surgeon places inside the chest and connects to the heart with wires.



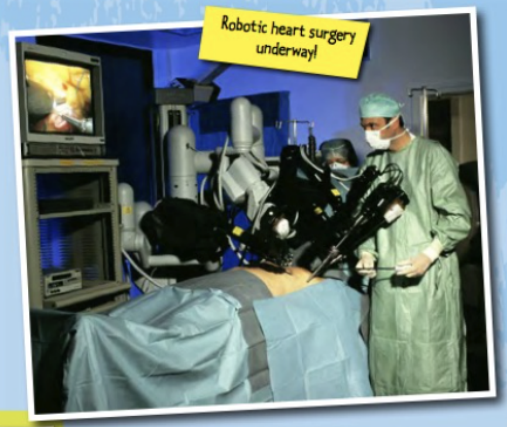
An X-ray image of a person's chest with a pacemaker

STRANGE BUT TRUE!

When heart pacemakers were first developed, today's tiny batteries were not available. The earliest pacemakers got their electricity from light fixtures, wall sockets—and even a windup generator!

Heart surgery

If someone's heart is damaged or malformed in some way, it can often be fixed with an operation. This no longer involves the doctor cutting a hole and sticking his finger into the patient's heart (see page 6)! In fact, the latest heart operations are done using robots controlled by the surgeon. The robot can fit into smaller spaces and cause less damage to the surrounding tissue.


Robotic heart surgery underway!

DON'T TRY THIS AT HOME!

The first-ever **heart transplant** happened in 1967. Louis Washkansky was given the heart of a young woman who had died in a car accident.

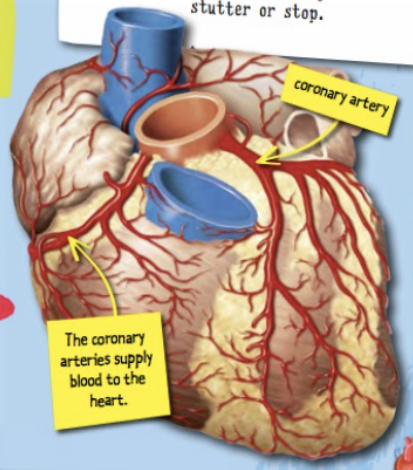
Despite the fact that Washkansky died 18 days later, surgeons considered the operation a success. Today, heart transplants are common. In the future, though, doctors may be able to fit people with mechanical hearts, which scientists have been developing since the 1950s.

DID YOU KNOW?

How much energy does it take to run a heart?

On average, your heart is estimated to use a minimum of 2.5 gigajoules of energy in your lifetime. That's enough to dry 232 loads of laundry in a clothes dryer!

Like all muscles, the heart needs a blood supply. If the **coronary** arteries around the heart become damaged or blocked, then it will be harder for blood to reach the muscle tissue. If too little blood reaches the heart, the heartbeat may stutter or stop.



MAINTENANCE AND SERVICING

Your heart does a lot of good work for you. It delivers oxygen and other supplies; takes away your body's waste products; fights off infections and illnesses; and serves as a messaging service for different parts of your body to keep in touch. It stands to reason you want to take care of it—but how?

BRILLIANT BODY FACT

Heart disease is not a modern-day problem—it has been discovered in 3,000-year-old mummies!

Exercise is good for your heart.

① Run a little, every day

Actually, you don't have to run—just get active. Your heart is a muscle, and like any other muscle, you can train it to be in good shape by making it work harder. Aim to exercise for 30 minutes five days a week. Try to work out hard enough to break a sweat.

② Don't start smoking

Smoking is really bad for your heart and circulation. It damages the lining of your arteries, causing them to narrow. The gases in tobacco smoke take up room in the blood, leaving less space for oxygen. Tobacco smoke also contains drugs that affect your heart rate, making your heart work harder than normal.

③ Watch your weight

Being overweight places a strain on your heart. Being heavy is like carrying around a loaded backpack all the time. Your heart has to work harder to circulate blood to your lungs and muscles.

④ Eat right

Avoid eating lots of fatty foods, such as french fries (in fact, anything deep-fried), butter, cheese, and cream; and treats such as cookies, cakes, and chocolate. Make sure you eat plenty of fruits and vegetables, and oily fish such as tuna, mackerel, or sardines.

A balanced diet includes plenty of fruits and vegetables.

Oily fish such as mackerel contain a kind of good fat called omega-3. Experts think omega-3 may improve the health of your heart.

⑤ Avoid extra salt

Eating salt makes it harder for your kidneys to remove excess water from your blood. Instead, the water builds up—which puts a strain on your heart and blood vessels.

⑥ Stressed? Walk or talk

Stress—feeling worried—is often associated with heart problems. If you feel worried about something, go for a walk outside to relax. If that doesn't work, talk to someone about what is bothering you.

Talking to a friend about a problem can help reduce stress.

See for yourself

Lots of people like to listen to music while exercising. Exercise increases your heart rate—but can music do the same thing? Try this experiment to find out:

Listen to something slow and relaxing for one minute. Take your pulse (see page 8 for how to do this).

Next, listen to an upbeat party song for one minute; take your pulse again.

Now compare results.

Was there a difference?

HEARTY WORDS!

Note: Some boldfaced words are defined where they appear in the book.

aorta An artery that takes oxygenated blood from the heart to the rest of the body

circulate To move around in a constant loop

clot A lump made by a liquid (such as blood) that thickens and sticks together

contracted Pulled together

coronary Relating to the heart

fatal Deadly

gravity The force of attraction between objects. Larger objects have greater gravity, so the Earth pulls objects toward itself more strongly than, for example, a tennis ball does.

heart transplant An operation in which a living person is given a new heart, donated by someone who has recently died

lymph nodes Swellings that are part of the lymphatic system, here lymph fluid is filtered and white blood cells are formed to destroy harmful microbes

microbe A tiny organism made of just a single cell

nutrient A food product that living things can use to survive, grow, or repair themselves

oxygen A colorless gas that is present in the air. Humans breathe in air and use the oxygen to release energy from food.

oxygenated With oxygen added

pacemaker An artificial device that tells the heart how often to beat

pulse A single heartbeat, or the speed at which someone's heart is beating. A pulse of 63 means your heart is beating 63 times per minute.

receptor The part of a cell within the human body that responds to a particular chemical signal

renal Relating to the kidneys

transfusion The transfer of blood into someone's body

valve In the heart or circulatory system, a valve is a one-way trapdoor that allows blood to pass before closing

HEARTY INFORMATION

Are you hungry for extra information about your heart? Here are some good places to find out more:

BOOKS TO READ

Burnstein, John. *The Amazing Circulatory System: How does my heart work?*, Crabtree Publishing, 2009

Leigh, Autumn. *The Circulatory System*, Gareth Stevens, 2012

Storad, Conrad J. *Your Circulatory System*, Lerner Classroom, 2012

WEBSITES

http://kidshealth.org/kid/htbw/heart.html
This website is a really good place to find out all sorts of information about the human body. It has an excellent section on the heart.

www.texasheart.org/projectheart/Kids/index.cfm
The Texas Heart Institute has all sorts of information for kids on the circulatory system. Listen to a heartbeat, check out a 3-D diagram of a heart, and learn all about ways to promote heart health on this engaging website.

PLACES TO VISIT

In Boston, Massachusetts, the Hall of Human Life at the Museum of Science has over 70 interactive exhibits about how the body works. The museum is located at:

Museum of Science
1 Science Park
Boston, MA 02114
www.mos.org

The Museum of Science and Industry in Chicago, Illinois, features YOU! The Experience, a permanent exhibition celebrating human life. The museum is located at:

The Museum of Science and Industry
5700 S. Lake Shore Drive
Chicago, IL 60637
www.msichicago.org

In Columbus, Ohio, the Center of Science and Industry explores the human body in their exhibition Life: The Story of You. The museum is located at:

Center for Science and Industry
333 W. Broad Street
Columbus, OH 43215
www.cosi.org